

VERMILION RIVER TMDL FOR FECAL COLIFORM
SUBSEGMENTS 060801, 060802

US EPA Region 6

with cooperation from the
Louisiana Department of Environmental Quality
Office of Environmental Assessment
Environmental Technology Division

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EXECUTIVE SUMMARY

Section 303(d) of the Federal Clean Water Act requires states to identify waterbodies that are not meeting water quality standards and to develop total maximum daily pollutant loads for those waterbodies. A total maximum daily load (TMDL) is the amount of a pollutant that a waterbody can assimilate without exceeding the established water quality standard for that pollutant. Through a TMDL, pollutant loads can be distributed or allocated to point sources and nonpoint sources discharging to the waterbody. A TMDL has been developed for fecal coliform bacteria for the Vermilion River.

The Vermilion River flows from its headwaters in South Central Louisiana to Vermilion Bay. Vermilion River segments 060801 and 060802 are listed on both the 1998 and the October 28, 1999 Court Ordered §303(d) Lists as not fully supporting the water quality standard for primary contact recreation (swimming). Louisiana's water quality standard for protection of the primary contact recreation use reads as follows:

“Based on a minimum of not less than five samples taken over not more than a 30-day period, the fecal coliform content shall not exceed a log mean of 200/100mL, nor shall more than 10 percent of the total samples during any 30-day period or 25 percent of the total samples collected annually exceed 400/100mL. These primary contact recreation criteria shall apply only during the defined recreational period of May 1 through October 31. During the non-recreational period of November 1 through April 30, the criteria for secondary contact recreation shall apply.”

The standard for secondary contact recreation reads similarly:

“Based on a minimum of not less than five samples taken over not more than a 30-day period, the fecal coliform content shall not exceed a log mean of 1,000/100 mL, nor shall more than 10 percent of the total samples during any 30-day period or 25 percent of the total samples collected annually exceed 2,000/100 mL.” Additional sampling conducted during the summer and fall of 1998 in the Vermilion River confirmed that the water quality standard was not supported.

For the purpose of TMDL development, the criteria of 200/100mL and 1,000/100mL were applied. TMDL fecal coliform loading curves for the recreational period (May 1 – October 31) and the non-recreational period (November 1 – April 30) have been generated as Figures 1 and 2. These TMDL loading curves are developed using Equation 1, substituting the criteria, 200 and 1000 cfu/100 ml, for FC concentrations and varying flows. The attempt here is to show that while a TMDL may be expressed as a single point it can also be thought of as a continuum of points representing the criterion value and various flow values. An 88% reduction in fecal coliform loading during the May – October season will be needed to meet the present standard for primary contact recreation in the summer season. A 70% reduction in fecal coliform loading during the November – April season will be needed to meet the standard for secondary contact recreation.

1. Introduction

Vermilion River segments 060801 and 060802 are listed on both the 1998 and the October 28, 1999 Court Ordered §303(d) Lists as not fully supporting the water quality standard for primary contact recreation (swimming). On the 1998 List, these segments of the Vermilion River are ranked as a high priority (1) for TMDL development. A TMDL for fecal coliform bacteria was developed in accordance with the requirements of Section 303 of the federal Clean Water Act. The purpose of a TMDL is to determine the pollutant loading that a waterbody can assimilate without exceeding the water quality standard for that pollutant; the TMDL also establishes the load reduction that is necessary to meet the standard in a waterbody. The TMDL consists of the wasteload allocation (WLA), the load allocation (LA), and a margin of safety (MOS). The wasteload allocation is the load allocated to point sources of the pollutant of concern, and the load allocation is the load allocated to nonpoint sources. The margin of safety is a percentage of the TMDL that accounts for the uncertainty associated with the model assumptions, data inadequacies, and future growth.

2. Study Area Description

2.1 Vermilion River, Segment 0608

The Vermilion River is the main stem river flowing through the Vermilion-Teche River Basin in South Central Louisiana. The Vermilion River flows from its headwaters at Bayou Fusilier near the town of Arnaudville through the city of Lafayette to Vermilion Bay. The Vermilion-Teche River Basin lies in the Western Gulf Coastal Plain ecoregion. The watershed is characterized as plains/prairie, and the land is generally flat with a very gradual slope toward the Gulf of Mexico. The predominant land use in the Vermilion River watershed is agricultural, consisting of cropland and pasture and comprising approximately 78% of the total acreage. Urban land use comprises approximately 10% of the land area in the watershed. Land use in the Vermilion River watershed, Segment 0608, is shown in Table 1. (LDEQ, 1993) Average annual rainfall in the Vermilion-Teche River Basin is near 60 inches, and average annual temperature is 68°F. The wet, warm climate of South Louisiana contributes to the elevated fecal coliform counts in the state's waterways. The heavy rainfall results in a large volume of runoff, and the warm to moderate temperatures are conducive to bacterial survival and reproduction.

Table 1. Land use in Segment 0608, Vermilion-Teche River Basin

LAND USE	ACREAGE	PERCENTAGE (%)
Agriculture	310,281	77.7
Urban	38,559	9.7
Forest	30,268	7.6
Wetland	14,832	3.7
Water	2,816	0.7

2.2 Water Quality Standards

The designated uses for the Vermilion River include both primary contact recreation and secondary contact recreation. Fecal coliform bacteria are the indicator used for the water quality criteria and for assessment of use support. Louisiana's water quality standard for protection of the primary contact recreation use reads as follows:

“Based on a minimum of not less than five samples taken over not more than a 30-day period, the fecal coliform content shall not exceed a log mean of 200/100mL, nor shall more than 10 percent of the total samples during any 30-day period or 25 percent of the total samples collected annually exceed 400/100mL. These primary contact recreation criteria shall apply only during the defined recreational period of May 1 through October 31. During the non-recreational period of November 1 through April 30, the criteria for secondary contact recreation shall apply.”

The standard for secondary contact recreation reads similarly:

“Based on a minimum of not less than five samples taken over not more than a 30-day period, the fecal coliform content shall not exceed a log mean of 1,000/100 mL, nor shall more than 10 percent of the total samples during any 30-day period or 25 percent of the total samples collected annually exceed 2,000/100 mL.”

2.3 Identification of Sources

The sources identified in the *1998 Louisiana Water Quality Inventory* as affecting the water quality of the Vermilion River are major and minor municipal point sources, small package treatment plants, minor industrial point sources, and agriculture (LDEQ, 1998). Agriculture in the watershed includes row crops, such as sugar cane, corn, sweet potatoes, and soybeans, and some ranching. Other sources of fecal coliform bacteria are wild and domesticated animals.

2.3.1 Point Sources

There are 139 facilities discharging sanitary wastewater into the Vermilion River and its tributaries. The combined flow of all these discharges is 30,820,052 gallons per day (see Appendix B).

2.3.2 Nonpoint Sources

The predominant land use in the Vermilion River watershed is agricultural, consisting of cropland and pasture and comprising approximately 78% of the total acreage. Urban land use comprises approximately 10% of the land area in the watershed. Both land use types contribute to fecal coliform loads through runoff, although it is unknown to what relative extent. Besides row crops, there are numerous acres of pasture/grazing land in the watershed where cattle and horses are raised. There are also numerous rural residences where other domesticated animals may be found. These rural residences may also contribute to the fecal coliform load if they have septic tanks or septic fields for their wastewater treatment.

3. TMDL Load Calculations

3.1 Current Load Evaluation

Fecal coliform loads have been calculated using the instream bacterial counts and the flow of the stream. The following equation can be used to calculate fecal coliform loads.

$$\text{Equation 1. } C \times 1000\text{mL} / L \times 1 L / 0.264 \text{ gallons} \times Q \text{ in gallons/day} = \text{cfu/day}$$

Where: C = colony forming units/100MI

Q = stream flow in gallons/day

A traditional expression of the FC loading may be developed by setting one critical or representative flow and concentration, and calculating the fecal coliform load using Equation 1. The difficulty with this approach is in the determination of the appropriate flow or concentration value to use. LDEQ has monthly monitoring data for three locations in Vermilion River: near Breaux Bridge, south of Lafayette, and at Perry. For the purpose of calculating the current fecal coliform load in Vermilion River, the data from the most downstream site at Perry was used. For the purpose of calculating current loading on the this waterbody the average fecal coliform concentration for the November – April and the May-October seasons. In the Vermilion River, the monthly fecal coliform counts ranged from 23 /100MI to > 16,000 /100MI over a 5-year period (January, 1995-December, 1999). The average fecal coliform count for the May – October season is 1666 cfu/100ml. The average fecal coliform count for the November – April season is 3246 cfu /100ml (see Appendix A). In addition, the average flow for the Vermilion River at Perry for the November – April season is 900 ft³/sec and for the May – October season is 600 ft³/sec (see Appendix C). Using these values and Equation 1 it is estimated that the current loading for the November – April season is 1.51 E14 cfu/day and the current loading for the May – October season is 2.44 E13 cfu/day (see Appendix A).

3.2 TMDL

Point sources usually have a defined critical receiving stream low flow such as the 7Q10 at which the criterion must be met. For nonpoint sources it is recognized that there may be no single critical flow condition. To address this condition, TMDL fecal coliform loading curves for the recreational period (May 1 – October 31) and the non-recreational period (November – April) have been generated as Figures 1 and 2. These loading curves were developed using Equation 1, substituting the criteria, 200 cfu/100 ml, and 1000 cfu/100ml for FC concentrations and varying flows. The attempt here is to show that while a TMDL may be expressed as a single point it can also be thought of as a continuum of points representing the criterion value and various flow values. These curves are not stream dependent but are dependent upon the designated stream criterion. Therefore, they may be applied to any stream with a like FC criterion. These curves represent the TMDL loading allocation for FC.

Figure 1. TMDL Fecal Coliform Loading Curve for the May – October season.

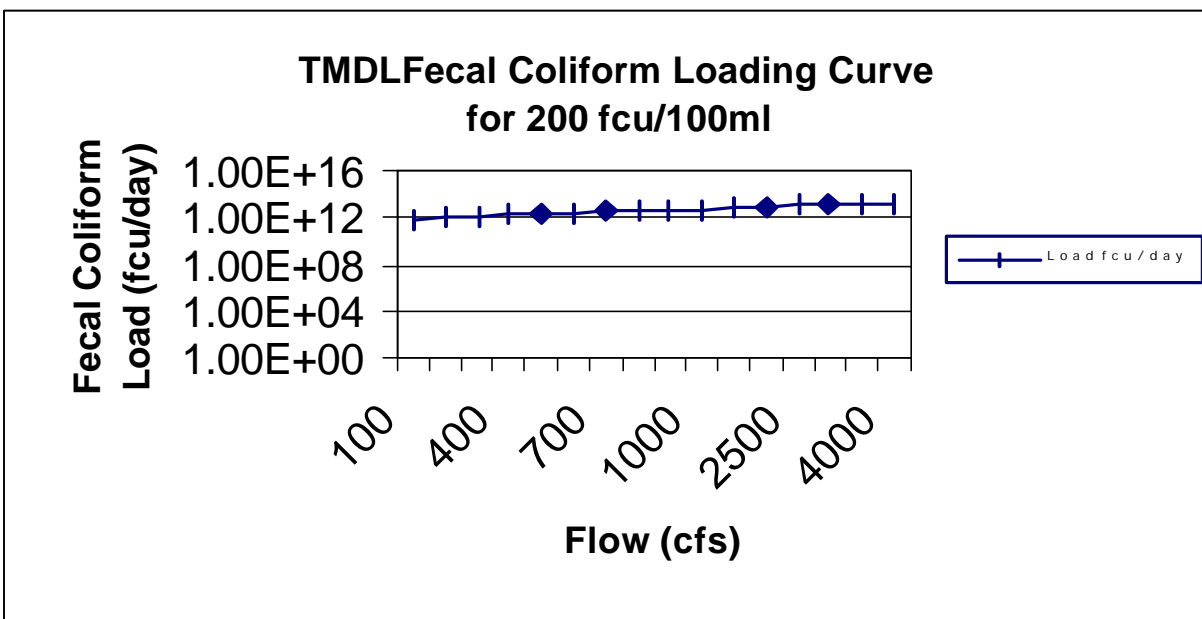
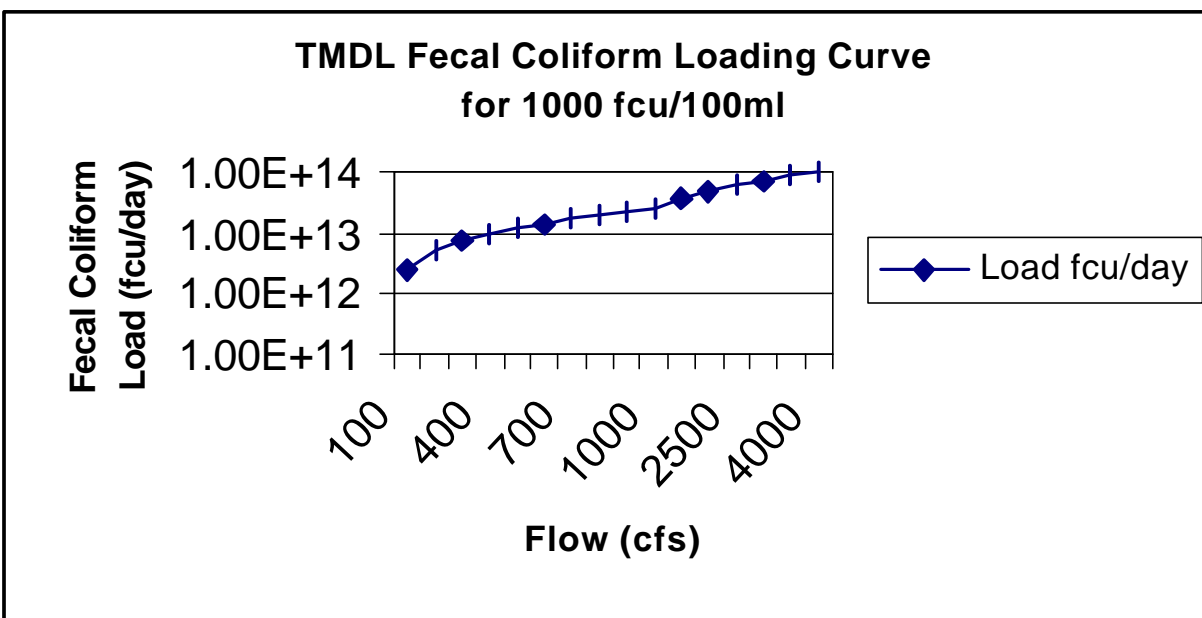


Figure 2. TMDL Fecal Coliform Loading Curve for the November - April season.



Utilizing Figures 1 and 2 one can select a stream flow and can quickly determine the TMDL FC loading value. The line formed by these series of points may be thought of as a boundary. At any given flow the loading may be below the line, within the boundary, or above the line. FC load values falling above the line represent disproportionately high values relative to the standard. FC load values falling below the line represent low loads relative to the standard. To

develop load reductions one simply needs to determine the appropriate flow value (x-axis) and see where it intersects the load allocation line.

The load reduction needed to meet the water quality standard for primary contact recreation in the Vermilion River during the May – October season at 600 cfs is 2.15 E13 cfu/day (88% reduction)¹. This was obtained by calculating the allowable TMDL at 600 cfs for the 200 cfu/100ml criterion (2.93 E12 cfu/day) and subtracting this load from the observed load (2.44 E13 cfu/day, see Appendix A).

$$\text{Current Load} - \text{TMDL} = \text{Load Reduction}$$

$$2.44 \text{ E13 cfu/day} - 2.93 \text{ E12 cfu/day} = 2.15 \text{ E13 cfu/day}$$

The load reduction needed to meet the water quality standard for secondary contact recreation in the Vermilion River during the November – April season at 1900 cfs is 1.05 E14 cfu/day (70% reduction)¹. This was obtained by calculating the allowable TMDL at 1900 cfs for the 1000 cfu/100ml criterion (4.64 E13 cfu/day) and subtracting this load from the observed load (1.51 E14 cfu/day, see Appendix A).

$$\text{Current Load} - \text{TMDL} = \text{Load Reduction}$$

$$1.51 \text{ E14 cfu/day} - 4.64 \text{ E13 cfu/day} = 1.05 \text{ E14 cfu/day}$$

3.3 Wasteload Allocation (WLA)

The Louisiana Water Quality Regulations require point source discharges of treated sanitary wastewater to maintain a fecal coliform count of 200 cfu/100 mL in their effluent, i.e., they must meet the standard at end-of-pipe. Therefore, there will be no change in the permit requirements based upon a wasteload allocation resulting from this TMDL.

Equation 1 can be used to calculate the total point source load (wasteload allocation) utilizing a fecal coliform count of 200 cfu/100 mL and the total volume of all the wastewater dischargers (30,820,052 gallons/day).

$$200 \text{ cfu/100mL} * 1000\text{mL/L} * 1 \text{ L}/0.264 \text{ gallons} * Q \text{ gallons/day} = \text{WLA}$$

Where Q = Total volume of sanitary wastewater discharges into Vermilion River

$$\text{WLA for all dischargers} = 2.33 \text{ E11 cfu/day}$$

¹ Expression of the load reduction percentage was adjusted since publication of the draft TMDL based on public comment; see EPA's response-to-comments at <http://www.epa.gov/earth1r6/6wq/tmdl.htm> for further explanation.

3.4 Load Allocation (LA)

The load allocation for each season for a given flow can be calculated using Equation 1 and the following relationship:

$(\text{TMDL@ given flow and criterion}) - (\text{WLA}) = \text{LA}$

LA for May – October season at an instream flow of 600cfs = 2.70 E12 cfu/day

2.93 E12 cfu/day (TMDL@ 600 cfs) – 2.33 E11 cfu/day (WLA) = 2.70 E12 cfu/day

LA for November – April season at an instream flow of 1900 cfs = 1.508 E14 cfu/day

1.51 E14 cfu/day (TMDL@ 1900 cfs) – 2.33 E11 cfu/day (WLA) = 1.508 E14 cfu/day

3.5 Seasonal Variability

Louisiana has established a seasonal water quality standard for bacteria based upon definition of a summer swimming season and winter secondary contact only. The TMDL fecal coliform loading curves have been developed for both seasons at all flows.

3.6 Margin of Safety (MOS)

The Clean Water Act requires that TMDLs take into consideration a margin of safety. EPA guidance allows for the use of implicit or explicit expressions of the margin of safety or both. When conservative assumptions are used in the development of the TMDL or conservative factors are used in the calculations, the margin of safety is implicit. When a percentage of the load is factored into the TMDL calculation as a margin of safety, the margin of safety is explicit. In this TMDL for fecal coliform, conservative assumptions have been used and therefore, the margin of safety is implicit. These conservative assumptions are:

- Using average seasonal flows to calculate current loading to obtain load reduction.
- Treating fecal coliform bacteria as a conservative pollutant, that is, a pollutant that does not degrade in the environment (bacteria do die off in the environment)
- Using the more conservative 200 cfu/100mL standard rather than 400 cfu/100mL for the summer primary contact recreational season and 1,000 cfu/100mL rather than 2,000 cfu/100mL for the winter season.
- Using the design flow of the point source dischargers rather than actual average flow rates, which are typically much lower

4. Other Relevant Information

Although not required by this TMDL, LDEQ utilizes funds under Section 106 of the federal Clean Water Act and under the authority of the Louisiana Environmental Quality Act to operate an established program for monitoring the quality of the state's surface waters. The LDEQ

Surveillance Section collects surface water samples at various locations, utilizing appropriate sampling methods and procedures for ensuring the quality of the data collected. The objectives of the surface water monitoring program are to determine the quality of the state's surface waters, to develop a long-term data base for water quality trend analysis, and to monitor the effectiveness of pollution controls. The data obtained through the surface water monitoring program is used to develop the state's biennial 305(b) report (*Water Quality Inventory*) and the 303(d) list of impaired waters. This information is also utilized in establishing priorities for the LDEQ nonpoint source program.

The LDEQ has implemented a watershed approach to surface water quality monitoring. Through this approach, the entire state is sampled over a five-year cycle with two targeted basins sampled each year. Long-term trend monitoring sites at various locations on the larger rivers and Lake Pontchartrain are sampled throughout the five-year cycle. Sampling is conducted on a monthly basis or more frequently if necessary to yield at least 12 samples per site each year. Sampling sites are located where they are considered to be representative of the waterbody. Under the current monitoring schedule, targeted basins follow the TMDL priorities. In this manner, the first TMDLs will have been implemented by the time the first priority basins will be monitored again in the second five-year cycle. This will allow the LDEQ to determine whether there has been any improvement in water quality following establishment of the TMDLs. As the monitoring results are evaluated at the end of each year, waterbodies may be added to or removed from the 303(d) list. The sampling schedule for the first five-year cycle is shown below. The Vermilion-Teche River Basin will be sampled again in 2003.

1998 – Mermentau and Vermilion-Teche River Basins
1999 - Calcasieu and Ouachita River Basins
2000 – Barataria and Terrebonne Basins
2001 – Lake Pontchartrain Basin and Pearl River Basin
2002 – Red and Sabine River Basins

(Atchafalaya and Mississippi Rivers will be sampled continuously.)

In addition to ambient water quality sampling in the priority basins, the LDEQ has increased compliance monitoring in those basins, following the same schedule. Approximately 1,000 to 1,100 permitted facilities in the priority basins were targeted for inspections. The goal set by LDEQ was to inspect all of those facilities on the list and to sample 1/3 of the minors and 1/3 of the majors. During 1998, 476 compliance evaluation inspections and 165 compliance sampling inspections were conducted throughout the Mermentau and Vermilion-Teche River Basins.

5. Public Participation

When EPA establishes a TMDL, 40 C.F.R. § 130.7(d)(2) requires EPA to publicly notice and seek comment concerning the TMDL. Pursuant to an October 1, 1999, Court Order, EPA prepared this TMDL. After submission of this TMDL to the Court, EPA commenced preparation of a notice seeking comments, information and data from the general and affected public. Comments and additional information were submitted during the public comment period and this Court Ordered TMDL was revised accordingly. EPA has transmitted this revised TMDL to the Court, and to the Louisiana Department of Environmental Quality (LDEQ) for incorporation into LDEQ's current water quality management plan.

REFERENCES

- LDEQ, 1993. *State of Louisiana Water Quality Management Plan, Volume 6, Part A: Nonpoint Source Pollution Assessment Report*. Louisiana Department of Environmental Quality, Office of Water Resources, Baton Rouge, La.
- LDEQ, 1998. *State of Louisiana Water Quality Management Plan, Volume 5, Part B: Water Quality Inventory*. Louisiana Department of Environmental Quality, Office of Water Resources, Baton Rouge, La.

APPENDIX A Fecal Coliform data and loading calculations for each season

Vermilion River at Perry, Louisiana

November – April		FECAL		May - October		FECAL
		COLIFORM				COLIFORM
DATE	TIME	MPN/100ML		DATE	TIME	MPN/100ML
-----	----	-----		-----	----	-----
12/07/1999	1115	2800		10/12/1999	1010	170
11/16/1999	1040	280		09/14/1999	915	500
04/13/1999	1045	300		08/10/1999	1040	500
03/09/1999	1040	300		07/13/1999	1159	2400
02/09/1999	1050	300		06/15/1999	1035	800
01/12/1999	1049	300		05/11/1999	920	16000
12/14/1998	1105	500		10/12/1998	1105	700
11/16/1998	1120	2400		09/14/1998	1100	2400
04/13/1998	1100	130		08/10/1998	1120	80
03/10/1998	1130	5000		07/13/1998	1103	280
02/09/1998	1000	1100		06/08/1998	1055	230
01/13/1998	900	9000		05/12/1998	1130	500
12/08/1997	1100	2400		10/13/1997	1140	130
11/18/1997	1100	1700		09/09/1997	1035	300
04/14/1997	1030	2400		08/11/1997	1010	3000
03/11/1997	1055	16000		07/15/1997	1115	9000
02/17/1997	1000	9200		06/09/1997	1055	900
01/07/1997	1100	3000		05/13/1997	1100	300
12/09/1996	1005	70		10/14/1996	1100	140
11/19/1996	1115	800		09/10/1996	1130	1300
04/08/1996	1100	9000		08/12/1996	1045	5000
03/11/1996	925	700		07/09/1996	1135	23
02/12/1996	945	1700		06/10/1996	1030	80
01/09/1996	1045	1300		05/14/1996	1035	500
12/11/1995	945	1100		10/10/1995	1030	2200
11/14/1995	847	1300		09/12/1995	1100	110
04/03/1995	915	900		08/14/1995	935	1600
03/13/1995	1025	5000		07/10/1995	1050	300
02/13/1995	1000	16000		06/12/1995	910	240
01/09/1995	1035	2400		05/08/1995	1005	300
	Average =	3246			Average =	1666
% Exceedance of 2000/100ml =		43%		% Exceedance of 400/100ml =		53%

		Flow	Fecal	Flow	Load	
		cfs	Count (fcu)	gal/day	fcu/day	
Current May - Oct Load		600	1666	387096774	2.44E+13	
Allowable May - Oct Load		600	200	387096774	2.93E+12	
% Load Reduction May – Oct		733				
Current November - April Load		1900	3246	1225806452	1.51E+14	
Allowable November - April Load		1900	1000	1225806452	4.64E+13	
% Load Reduction Nov - April		225				

APPENDIX B Dischargers in Subsegment

NOTE: For copies of Appendix B please contact Ellen Caldwell, EPA Region 6, 1445 Ross Avenue, Dallas, Texas 75202 or call (214) 665-7513.

APPENDIX C Flow calculation methodology

January 27, 2000

DETERMINATIONS OF AVERAGE STREAMFLOW FOR SELECTED LADEQ WATER QUALITY STATIONS IN LOUISIANA.

Note: *The* "average streamflow" is defined to be the annual average streamflow.

Bayou Des Cannes northeast of Jennings (DEQ # 0308 and 0647) - Based on the runoff for the USGS station on Bayou Des Cannes near Eunice, 2.11 CFS per square mile, and a drainage area for the 308 site of 368.69 square miles, the average streamflow is estimated to be 778 CFS. . The May - October average flow is estimated to be about 73% of the annual average flow; the November - April average flow is estimated to be about 127 % of the annual average flow.

Bayou Nezpique at La. 104 north of Basile (DEQ 005) -- Based on the runoff for the USGS station on Bayou Nezpique near Basile, 1.89 CFS per square mile, and a drainage area for the 005 site of 327.62 square miles, the average streamflow is estimated to be 619 CFS. . The May - October average flow is estimated to be about 47% of the annual average flow; the November - April average flow is estimated to be about 153 % of the annual average flow.

Bayou Nezpique at La. 97 near Jennings (DEQ 309) -- Based on the runoff for the USGS station on Bayou Nezpique near Basile, 1.89 CPS per square mile, and a drainage area for the 309 site of 580 square miles, the average streamflow is estimated to be 1,096 CFS. The May - October average flow is estimated to be about 47% of the annual average flow-, the November - April average flow is estimated to be about 153 % of the annual average flow.

Bayou Nezpique at boat landing near Jennings (DEQ 651) - Based on the runoff for the USGS station on Bayou Nezpique near Basile, 1.89 CFS per square mile, and a drainage area for the 651 site of 585 square miles, the average streamflow is estimated to be 1, 106 CFS. The May - October average flow is estimated to be about 47% of the annual average flow; the November - April average flow is estimated to be about 153 % of the annual average flow.

Bayou Plaquemine Brule at Refinery (DEQ 650) - Based on the runoff for the USGS station on Bayou Des Cannes near Eunice (best available estimator), 2.11 CFS per square mile, and a drainage area for the 650 site of 331.87 square miles, the average streamflow is estimated to be 700 CFS. The May - October average flow is estimated to be about 73% of the annual average flow; the November - April average flow is estimated to be about 127 % of the annual average flow.

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Bayou Boeuf at mouth (DEQ 668) - Based on the runoff for the USGS station on Bayou Courtableau near Washington, 1.56 CPS per square mile, and a drainage area for the 668 site of 234.33 square miles, the average streamflow is estimated to be 312 CFS. The May - October average flow is estimated to be about 53% of the annual average flow; the November - April average flow is estimated to be about 147% of the annual average flow.

Bayou Teche at Breaux Bridge (DEQ 03 1) -- Based on the adjusted runoff for the USGS station on Bayou Teche at Arnaudville and a subtraction of the estimated average flow for Bayou Fusilier, the estimated average streamflow is 760 CFS. The May - October average flow is estimated to be about 76% of the annual average flow; the November - April average flow is estimated to be about 124 % of the annual average flow.

Bayou Teche at Adeline (DEQ 030) – With the assumption that the average streamflow for the USGS station on Bayou Teche at Keystone Lock and Dam is the same as the average streamflow at Adeline, the estimated average streamflow for Site DEQ 030 is 491 CFS. The May-October average flow is estimated to be about 78% of the annual average flow; the November-April average flow is estimated to be about 122% of the annual average flow.

Vermilion River at Perry (DEQ 001) – Based on DEQ determinations for Vermilion River at Surrey Street in Lafayette using USGS data for the period 94-97, the average flow for the Vermilion River at Perry is about 750 CFS. For May-October, the average flow is estimated to be about 600 CFS; for November- April, the average flow is estimated to be about 900 CFS.